FINAL REPORT

THE EFFECT OF SHELTERBELTS ON CROPPING PRACTICES

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The Effect of Shelterbelts on Cropping and Tillage Practices

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Indian Head Agricultural Research Foundation

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Shelterbelt Project

Income:	
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Total Income	$15,850.00
Expense:	
Contract Work	$17,120.00
Postage	43.57
Travel	4,955.12
Admin.	900.00
Total Expense	$23,018.69
Net Income	$ -7,168.69

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INTRODUCTION

By sheltering vulnerable land from wind, shelterbelts have been shown to reduce soil erosion, improve moisture conditions by trapping snow, and provide wildlife habitat. Furthermore, the improved microclimate caused by the combined benefits of moisture conservation and reduced wind erosion significantly increase crop yields (Kort, 1988).

This study was undertaken to determine whether shelterbelts affected the cropping and tillage choices made by producers. In particular, there were two main objectives:

1) to determine if producers who farm land protected by shelterbelts make different cropping choices than producers who farm unsheltered land, and;

2) to determine if producers who farm sheltered land differ from producers who farm unsheltered land in the type and amount of tillage practices, including the use of summerfallow and/or chemfallow.

It is important to understand how shelterbelts affect farming operations to ensure that shelterbelt programs and design recommendations are compatible with modern farming operations

The project was undertaken as a two-fold survey:

1) by field reconnaissance in 1997 of field sizes and crops on randomly-sampled quarter sections with or without shelterbelts,

2) by a follow-up survey mailed to randomly-selected producers farming with or without shelterbelts in the inspected rural municipalities.

The study focused on four Rural Municipalities(R.M.'s) (hereafter referred to by their specific RM names; "Auvergne" and "Fertile Valley" in Saskatchewan, and "Edward" and "Stanley" in Manitoba), where well-developed networks of mature shelterbelts are established. The RM of Fertile Valley is found in the Conquest area of central Saskatchewan, and the RM of Auvergne is located in the Ponteix area in southwest Saskatchewan. The RM's of Edward and Stanley are found in the southwest and south central areas of Manitoba near Lyleton and Winkler, respectively.

METHODOLOGY

Field Survey

A field inventory was undertaken in the summer of 1997 in which a comparable number of sheltered and unsheltered quarter sections were inspected. The data recorded consisted of the number and size of fields and, for each field, the crop grown, and the number and size of fields in summerfallow.

Sheltered quarter sections were defined as those having at least 70% of the field area sheltered by rows of trees. Similarly, unsheltered quarter sections were those without shelterbelts, or with a land base in which 30% or less was protected by shelterbelts (i.e. a quarter section with a single shelterbelt was categorized as an unsheltered quarter).

Field sizes were determined by aerial photographs, and verified by visual inspections. Fields were categorized in nine, 20-acre increments.

A total of 228 and 287 quarter sections were inspected in Auvergne and Fertile Valley, respectively. A further 188 and 168 quarter sections were inspected in Stanley and Edward, respectively.

Producer Survey

Questionnaires were mailed to producers in each RM. Quarter sections were chosen from aerial photographs and categorized as unsheltered or sheltered land, and landowners were subsequently identified from landowner maps. The primary criteria for landowners were that they:

1. farmed/owned more than one quarter section in the target RM,

2. farmed predominantly either sheltered land or unsheltered land.

The latter criterion was confirmed by questions in the survey.

Producers were asked to describe their tillage and cropping practices, as well as to rate environmental and market factors affecting their management decisions. Producers also provided specific details concerning field sizes, seeded crops and crop acreage for the years 1993-1997 inclusive (see Appendix III). The producer survey crop data was averaged over five years, giving an estimate of crop diversity and seeded acreage. In contrast, the field survey data provided a one season snapshot of farming practices and served as a comparison between long-term and short-term data. Responses were received from Fertile Valley (26), Auvergne (22), Stanley (9) and Edward (14).

BACKGROUND PHYSIOGRAPHY

Table 1 contains background physiography data about the four RM's studied. The sources are noted in the table.

Table 1. General physiography of soil associations

Soil Series	Soil Texture	Topography	Comments
RM of Fertile Valley (Dark Brown Soil Zone) Ellis et al, (1968)			
Asquith	sandy loam, fine sandy loam, loamy sand, combinations with <15% clay	very gently to gently undulating	Severe limitations that restrict the choice of crops or require special conservation practices or both. Low to medium in productivity and may be capable only of producing perennial forages. Insufficient moisture-holding capacity.
Bradwell	fine sandy loam, very fine sandy loam, loam, fine sandy clay loam, very fine sandy clay loam	gently to roughly undulating topography local areas of steeper sloping and undulating to rolling landscapes	Moderately severe limitations that reduce the choice of crops or require special conservation practices. medium to moderately high in productivity for a moderate range of field crops. Insufficient moisture holding capacity
Elstow	loam, silt loam, clay loam, silty clay loam	very gently sloping to roughly undulating topography. Some rolling topography also occurs	Moderately severe limitations that reduce the choice of crops to require special conservation practices. Medium to moderately high in productivity for a moderate range of field crops. Insufficient moisture holding capaicty.

RM of Auvergne (Brown Soil Zone)		**Saskatchewan Institute of Pedology (1989)**	
Ardill	Clay loam to fine sandy loam	gently sloping to strongly sloping	Moderately severe limitations that reduce the choice of crops or require special conservation practices. Medium to moderately high in productivity for a moderate range of field crops. Insufficient moisture holding capacity. Saline areas on lower slopes.
Hatton	sandy loam to loamy sands	gently to moderately sloping	Severe to very severe limitations that restrict the choice of crops or require special conservation practices or both. Low to medium in producitvity and may be capable only of producing perennial forages. Insufficient moisture holding capacity.
Valor	loam to silty loam	very gently to gently sloping topography	Moderately severe limitations that reduce the choice of crops or require special conservations practices. Medium to moderately high in productivity for a moderate range or field crops. Insufficient moisture holding capacity.
RM of Stanley (Black Soil Zone)		**Smith and Michalyna (1973)**	
Gnadenthal	fine loam	smooth, level to very gently sloping	No significant limitations that restrict their use for crops.
Hochfeld	fine sandy loam	smooth, level to very gently sloping susceptible to wind erosion because of sandy texture and poor aggregate structure	Moderately severe limitations that reduce the choice of crops or require special conservation practices. Insufficient moisture holding capacity.
Horndean	clay loam to loam	level areas	Moderate limitations that reduce the choice of crops or require moderate conservation practices. High spring groundwater levels. Take longer to warm up in the spring and dry out following rains than do moderately fine-textured soils.
Newtom	clay to loam	level to very gently sloping	No significant limitations that restrict their use for crops. Slightly saline areas occur where there is poor drainage.
Rosengart	loam to fine sandy loam	level to very gently sloping	No significant limitations that restrict their use for crops.
Neuenberg	fine sandy loam	smooth, level to gently sloping	No significant limitations that restrict their use for crops.
Reinland	fine sandy loam	smooth, level to gently sloping	Moderate limitations that reduce the choice of crops or require moderate conservation practices. Somewhat droughty and if not protected, susceptible to wind erosion.

RM of Edward (Black Soil Zone) Ellers et al (1978)			
Souris	loamy sand	nearly level to depressional with simple and complex slopes	Moderately severe limitations that restrict the range of crops or require special conservation practices. Moisture limitations due to coarse soil texture and low water holding capacity.
Hartney	loam - saline phase	level to very gently sloping complex topography	Severe limitations that restrict the range of crops or require special conservation practices, or both. Soils adversely affected by presence of soluble salts.
Lauder	loamy sand	level topography	Moderately severe limitations that restrict the range of crops or require special conservation practices. Moisture limitations due to coarse soil texture and low water holding capacity.
Montgomery	loam-saline phase	gently sloping to depressional topography	Severe limitations that restrict the range of crops or require special conservation practices, or both. Adversely affected by the presence of soluble salts. Surfaces often slightly stony.
Waskada	loam	complex, gently sloping	No significant limitations in use for crops; moderately high to high productivity for field and vegetable crops. Usually occur in intermediate and upper slope positions, and knolls are sometimes slightly to moderately eroded.

RESULTS

Field Size

Areas with shelterbelts had, on average, smaller field sizes than areas without shelterbelts (Fig. 1a-d). In sheltered areas, fields of 80 acres or less comprised 96% and 93% of the total number of fields in the Saskatchewan and Manitoba RM's, respectively (Fig. 2b). However, the effect of shelterbelts of field sizes was greater in Manitoba where only 53% of the unsheltered fields were 80 acres or less (Fig. 2a) In the Saskatchewan RM's, 91% of the unsheltered fields were 80 acres or less (Fig. 2a). The small size of unsheltered fields in Saskatchewan was mainly due to strip-cropping, reflecting the greater risk perceived for wind erosion in Saskatchewan, especially in the RM of Auvergne. The lower risk of wind erosion in Manitoba and perhaps the greater ability to adopt reduced tillage technology or continuous cropping because of higher precipitation could explain the use of larger fields there in the absence of shelterbelts.

There was general agreement of the producer survey with the field survey although the producer responses represented fewer fields, thereby resulting in a greater degree of variability. In unsheltered fields, 100% and 67% of the fields were reported to be 80 acres or smaller for the Saskatchewan and Manitoba RM's, respectively (Fig. 2c). In sheltered fields, 98% of fields were reported to be 80 acres or less for both Manitoba and Saskatchewan (Fig. 2d).

These results were in agreement with the responses of producers to survey Question 17 (Table 2) in which 30% of all producers with shelterbelts said that their field size was affected by the shelterbelts, implying that, without the shelterbelts, the field sizes would likely be different. Particular comments to this question included the following:

- "... your field size can only be as big as your shelterbelts allow."
- "... because of shelterbelts, field size is small ..."
- "Field size was set many years ago when the trees were planted."
- "The field size will always be the same..."

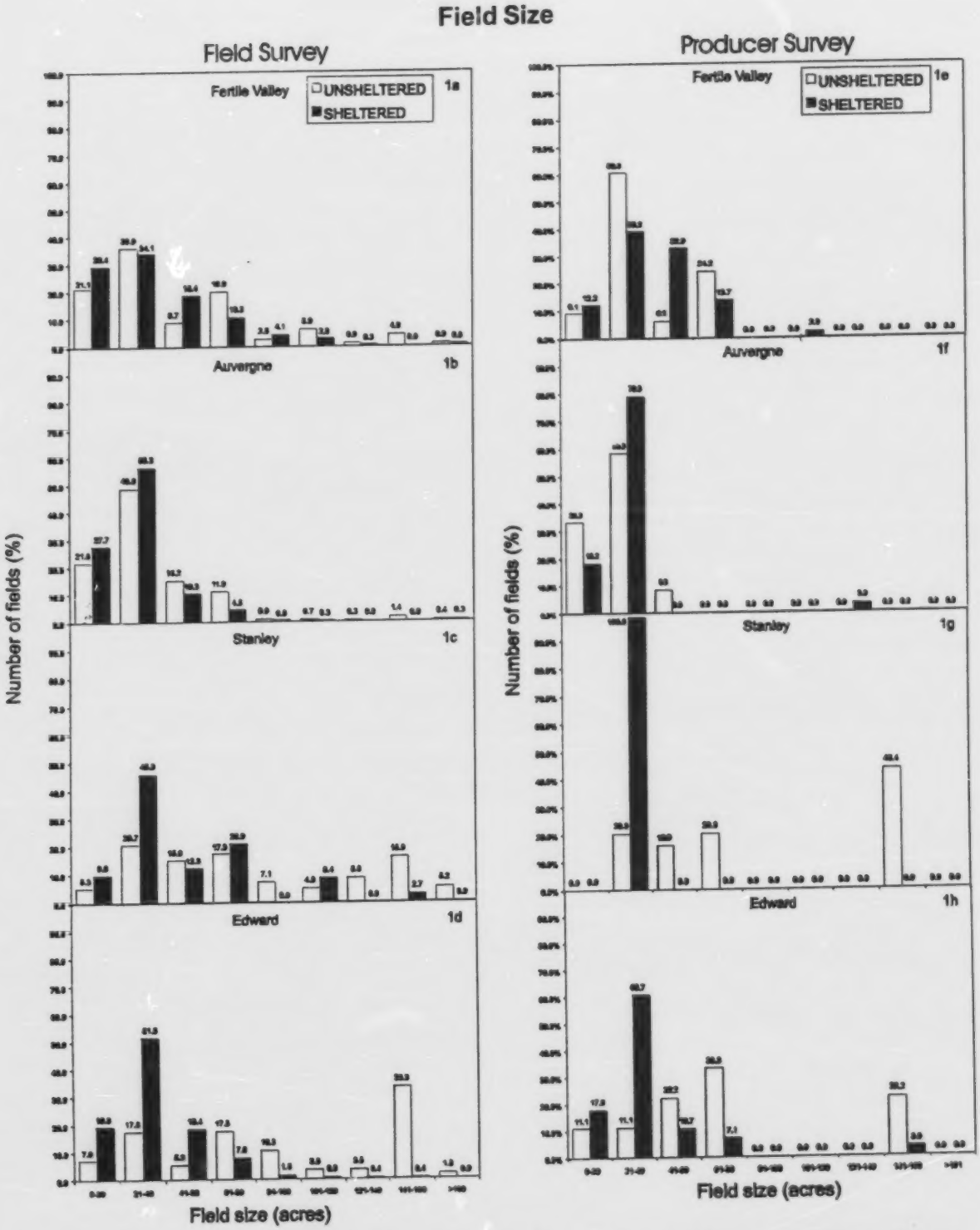

Figure 1a-h. Percent of fields in different size categories as influenced by the presence or absence of shelterbelts - Field Survey (1a-1d) and Producer Survey Results (1e-1h).

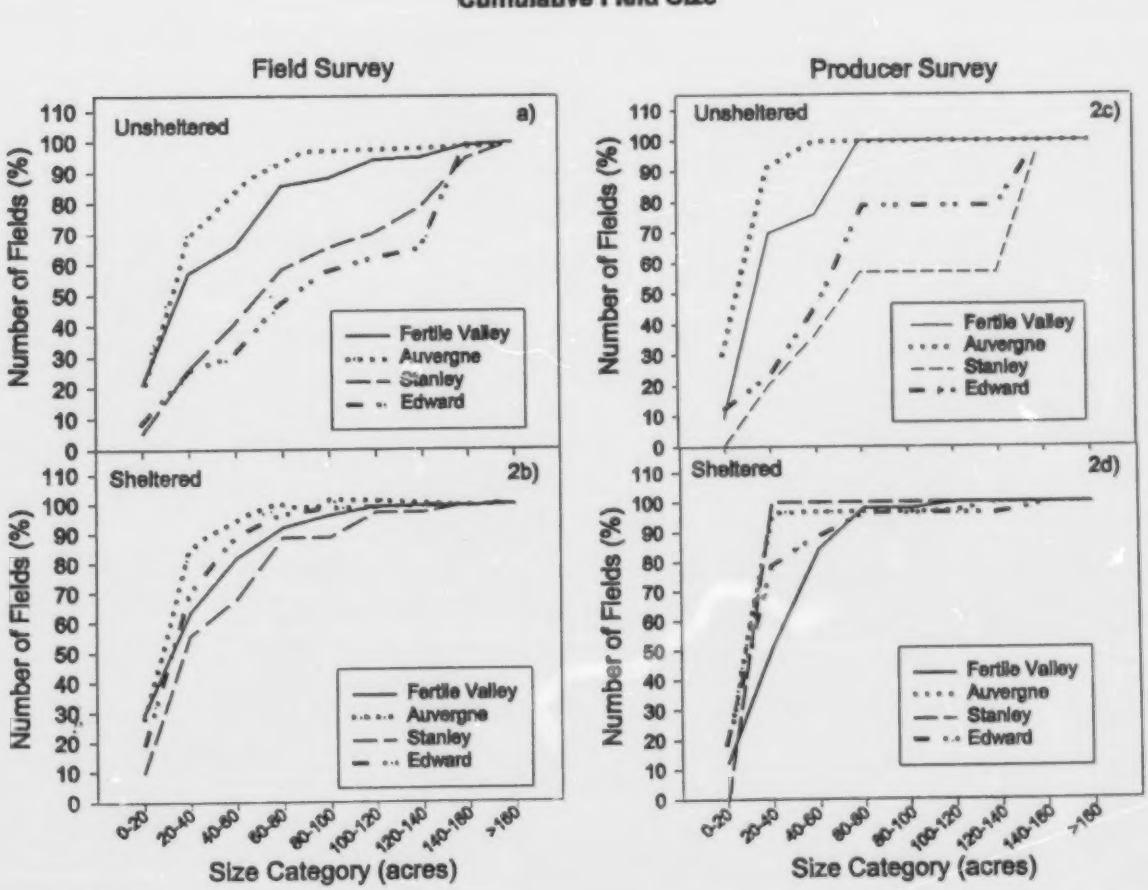

Figure 2a-d. Cumulative percent of fields in increasing field size categories for two Saskatchewan RM's (Fertile Valley and Auvergene) and two Manitoba RM's (Stanley and Edward).

These comments are further supported by the responses to Question 15 (Appendix I) in which shelterbelts were identified as one of the most important factors influencing field size.

Table 2. Responses of producers with shelterbelts about shelterbelt influences on cropping and tillage practices.

Question 17 - Do shelterbelts affect the following management decisions? (% Yes)					
	Fertile Valley	Auvergne	Stanley	Edward	All
Field Size	19	36	80	18	30
Crop choice	75	60	80	64	69
Tillage freq.	7	30	0	0	10
Fallow acreage	13	20	20	27	20

Crop Diversity

The Manitoba RM's of Stanley and Edward had a greater diversity of crops than the Saskatchewan RM's while the least crop diversity was found in the Saskatchewan RM of Auvergne (Figure 3). This is likely due mainly to the differences in climatic conditions among the regions but other factors such as the availability of irrigation and the existence of local processors in Manitoba give producers the option to grow crops such as sugar beets and potatoes.

Table 3. List of crop abbreviations used in Figure 3.

Abbr.	Crop	Abbr.	Crop	Abbr.	Crop	Abr.	Crop
BARL	barley	CHKP	chickpeas	MSTD	mustard	SUNF	sunflowers
BEAN	dry beans	CORN	corn	OATS	oats	TFOR	tame forage
BEET	sugar beets	FLAX	flax	ONIO	onions	TRIT	triticale
BKWT	buckwheat	LENT	lentils	PEAS	peas	WHT	wheat
CANA	canaryseed	LINO	linola	POTA	potatoes		
CANO	canola	MILL	millet	RYE	fall rye		

A crop diversity index was developed (Equation 1) to determine whether a difference in the diversity of cropping choices could be discerned between unsheltered and sheltered fields (Table 4). The index took into account both the number of crops grown and the proportion of the total crop area occupied by each crop. A weighted average was also calculated which took into account the total number of acres of each crop over all four RM's. This was considered more useful than a simple average, especially for the producer survey, due to the difference in the number of responses from each RM.

The index was calculated as:

$$= - \sum_{-} \qquad \text{(Equation 1)}$$

in which: *Div* = diversity index; *crop* = a particular crop; *l* = the number of crops; and *p* = the proportion of the total acreage (not including summerfallow acreage) in an area occupied by a particular crop.

Table 4. Crop diversity index (Equation 1) for sheltered and unsheltered areas

RM	Field Survey		Producer Survey	
	Unsheltered	Sheltered	Unsheltered	Sheltered
Fertile Valley	0.733	0.765	0.662	0.663
Auvergne	0.341	0.331	0.482	0.404
Stanley	0.845	0.862	0.808	0.730
Edward	0.833	0.858	0.747	0.836
Weighted average	0.773	0.811	0.723	0.741

The crop diversity index appeared to be a good indicator of crop diversity because it accounted for both the number and acreage of crops grown. Because of the greater number of crops grown in the Manitoba RM's the index was greater than that for Auvergne. Because of the greater acreage of minor crops, the RM of Stanley, according the field survey, gave an average diversity index of 0.854 (sheltered and unsheltered) compared to 0.749 in Fertile Valley even though the number of crops grown were almost the same.

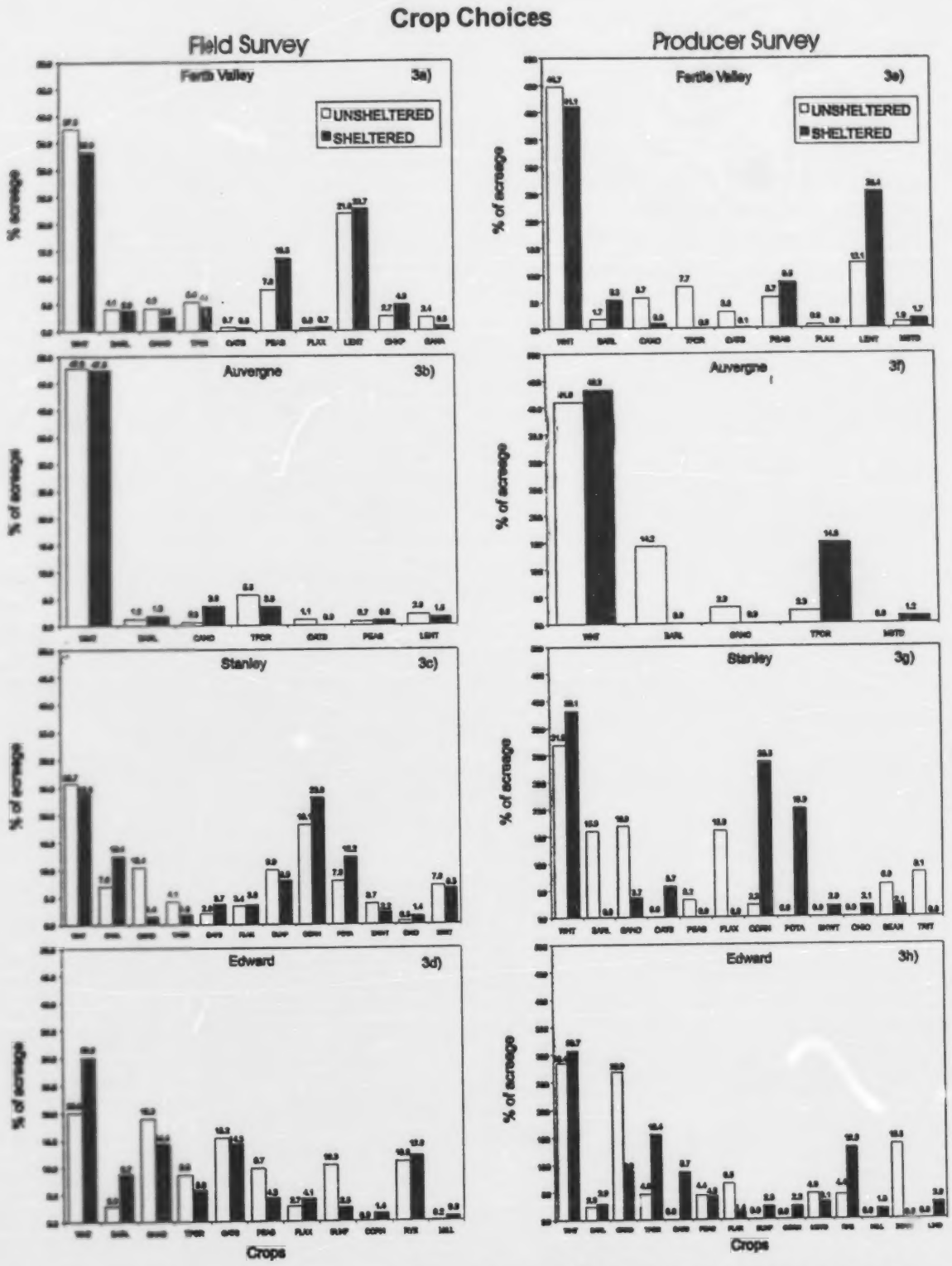

Figure 3a-h. Percent of total acreage in different crops as influenced by the presence or absence of shelterbelts - Field Survey (3a-3d) and Producer Survey (3e-3h) results. (Crop Abbreviations are summarized in Table 3).

The weighted average crop diversity index for both the field and producer survey were slightly higher for sheltered areas than for unsheltered areas. In the field survey, the sheltered areas had a greater diversity index in three of the four RM's. In the producer survey, the sheltered areas had a greater diversity in only two of the RM's. Most of the producers who farm with shelterbelts felt that their shelterbelts influenced their crop choices allowing them to grow crops such as low-residue crops or wind-sensitive crops which they might not grow without the shelterbelts (Table 2). Particular comments to Question 17 (Table 2) included the following:

- "I have 2-rod strips of forage established on east side of shelterbelts."
- "... allows planting of low-residue crops."
- "Potatoes ... need good protection from the wind since they add little to the soil and harvest procedure leaves the land very susceptible to wind erosion."

Despite the variability of the data, the crop diversity index values combined with producer comments, led to the conclusion that the use of shelterbelts resulted in an increase in crop diversity.

Tillage Practices

There was little difference in the amount of summerfallow between unsheltered and sheltered areas but there appeared to be an effect of shelter in the RM of Fertile Valley (Fig. 4).

In Fertile Valley, the field and producer surveys showed a range of 10.5% to 20.8% of the land in fallow (sum of percentage in summerfallow and chem fallow). Both surveys showed a greater percentage of fallow land in the unsheltered land than in the sheltered land, 20.8% (unsheltered) vs 15.7% (sheltered) in the field survey and 12.9% (unsheltered) vs 10.5% (sheltered) in the producer survey. This difference could be due to better moisture levels or higher crop yields in sheltered fields, and also coincides with an increase in crop diversity in sheltered fields in that RM.

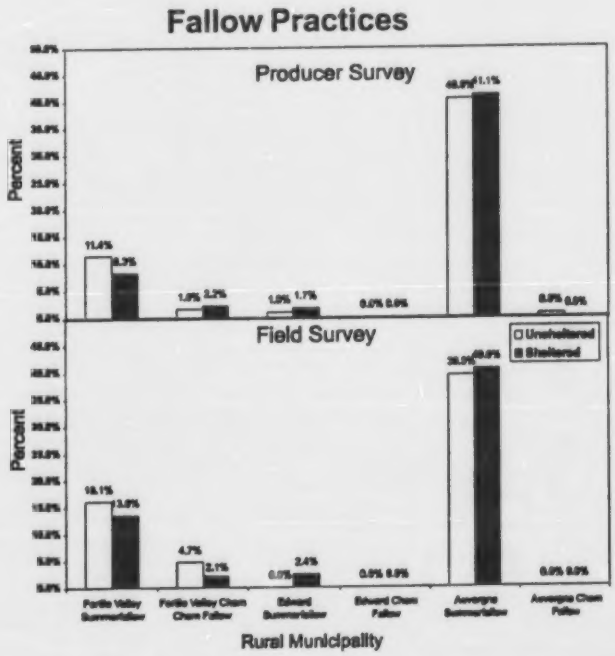

Figure 4. Percent of total acreage in summerfallow and chemfallow as influenced by the presence or absence of shelterbelts - Field Survey and Producer Survey.

In Auvergne, there was no difference in the amount of summerfallow in unsheltered and sheltered areas (Fig.4). In this area, the need to use summerfallow as a low-input way to accumulate soil moisture and soil nitrogen and the reduced crop diversification options evidently influenced the decision to put the land in fallow more than any benefits of the shelterbelts.. The use of strip-cropping in the unsheltered areas or of shelterbelts allowed producers to use summerfallow at the same rates while protecting the soil from wind erosion.

There was no summerfallow in the RM of Stanley and only a little in Edward RM.

It appeared from Question 17 (Table 2), that some producers who had shelterbelts felt that the presence of the shelterbelts influenced the acreage of summerfallow but, with the exception of the RM of Fertile Valley, there was little difference apparent, either from the field survey or the producer survey.

In response to Question 17 (Table 2), most producers with shelterbelts did not feel that shelterbelts affected their tillage frequency. However, one comment was made that "with tree strips, I can work it an extra time and trees will slow down winds and help stop soil from blowing." It appeared, from the responses to Question 12 (Table 5) that there was a slightly higher frequency of cultivations in sheltered fields than in unsheltered fields. This could also be due to greater weed growth in the sheltered fields caused by higher soil moisture and higher temperatures.

Table 5. Frequency of cultivation (from producer survey Question # 12)

# of cultivations	% of producers	
	Unsheltered	Sheltered
2	7	0
2/3	7	9
3	43	18
3/4	29	18
4	14	46
5	0	9
Total	100	100

DISCUSSION

Shelterbelts appeared to play a role in cropping and tillage practices but that role appeared to be different in each of the four RM's surveyed.

In the RM of Fertile Valley, sheltered and unsheltered fields did not differ in size, mainly because producers in the unsheltered areas limited the size of their fields, many by strip-cropping, due to a concern about wind erosion. In the questionnaire responses, 40% of producers on unsheltered land identified wind erosion as an important factor limiting crop yield (Appendix I Question 13c) while only 33% of producers on land protected by shelterbelts felt that wind erosion was an important limitation. In Fertile Valley, there was also a slightly greater diversification of crops in sheltered fields and a decrease in the area fallowed.

In the RM of Auvergne, both sheltered and unsheltered fields were small, as in Fertile Valley. In this case, the small size of the unsheltered fields was clearly due to the widespread adoption of strip-cropping as a protection against wind erosion (Appendix I Question 14a). As in Fertile Valley, more producers in the unsheltered area rated wind erosion as an important limitation to crop yields. Because cropping choices were less in this area, however, crop diversity was not greater on the sheltered fields than on the unsheltered fields. Producers identified soil moisture as being the second most important consideration (after crop prices) in their cropping decisions (Appendix I Question 5). The use of summerfallow did not differ between unsheltered and sheltered areas. It was concluded that, in this RM, climatic conditions were so dominant that shelterbelts had no effect on cropping and tillage practices.

In the RM's of Stanley and Edward, unsheltered fields were generally larger than fields with shelterbelts. This was recognized by producers (Appendix I Question 15g). Producers in both RM's cited wind erosion as an important factor limiting crop yields (Appendix ! Question 13c). This likely accounted for the fact that the producers in neither the unsheltered nor the sheltered areas fallowed their land. Producers in these RM's had many cropping choices available to them and there appeared to be slightly more crop diversification among producers in the sheltered areas, perhaps because of the small field size as well as the protection from the shelterbelts.

Shelterbelts affected one or more farm practices in all the RM's studied but it was apparent that, because of the many other factors to be considered by the producers, shelterbelt effects in cropping and tillage choices were generally small. The surveys showed, however, that many producers considered wind erosion to be an important factor limiting crop yields and tried to minimize it with measures such as shelterbelts, strip-cropping and continuous cropping.

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Appendix I. Answers to Conservation Questions from Producer Survey

		Fertile Valley	Auvergne	Stanley	Edward	All RM's
1. Q#5 - How would you rate the following in terms of their importance in determining what crops you seed? (% important or very important)						
a. commodity price	Unshelt	80	91	100	100	89
	Shelt	94	91	100	90	93
b. distance to elevators	Unshelt	86	58	25	100	64
	Shelt	50	60	40	33	47
c. crop rotation	Unshelt	78	70	100	100	81
	Shelt	93	44	100	78	79
d. input costs	Unshelt	78	91	75	100	85
	Shelt	100	70	80	78	85
e. soil moisture conditions	Unshelt	89	91	100	100	92
	Shelt	87	80	80	89	85
f. conservation concerns	Unshelt	100	80	50	100	88
	Shelt	79	60	80	100	82
g. equipment restrictions	Unshelt	100	80	75	100	88
	Shelt	87	60	80	100	82
h. crop management level	Unshelt	100	80	75	100	88
	Shelt	93	50	80	78	76
i. rockiness	Unshelt	40	40	67	50	45
	Shelt	50	70	67	67	61
2. Q#13 - How would you rate the following in their effect on crop yields in this quarter section? (% important or very important)						
a. salinity	Unshelt	22	50	0	0	27
	Shelt	75	33	60	44	56
b. water erosion	Unshelt	13	36	50	0	27
	Shelt	44	22	60	33	38
c. wind erosion	Unshelt	40	45	50	67	48
	Shelt	33	33	60	78	52
d. rockiness	Unshelt	0	50	0	0	21
	Shelt	29	10	0	33	21
e. hilliness	Unshelt	29	30	0	0	21
	Shelt	7	11	0	11	8
f. drainage	Unshelt	43	33	0	0	26
	Shelt	60	11	60	44	45
3. Q#15 - How would you rate the following for their importance in determining the field size on this quarter section? (% important or very important)						
a. hills	Unshelt	29	25	25	0	24
	Shelt	9	0	0	0	3
b. waterways	Unshelt	29	40	75	100	48
	Shelt	46	11	40	0	25
c. equipment size	Unshelt	43	11	50	67	35
	Shelt	27	33	40	11	28
d. crop rotation	Unshelt	67	50	50	50	56
	Shelt	64	38	100	11	48
e. bush	Unshelt	0	13	50	100	24
	Shelt	9	0	20	11	9
f. sloughs	Unshelt	57	38	25	50	43
	Shelt	50	30	20	33	36
g. shelterbelts	Unshelt	33	13	0	0	20
	Shelt	82	50	100	67	77
4. Q#14 - Are any of the following used on this quarter section? (% Yes)						
a. strip-cropping	Unshelt	50	100	0	0	59
	Shelt	6	70	0	36	29
b. grass barriers	Unshelt	20	8	25	0	14
	Shelt	6	20	0	9	10
c. permanent forages	Unshelt	20	18	25	0	18
	Shelt	13	40	0	22	21
d. grassed waterways	Unshelt	11	42	75	0	32
	Shelt	19	30	20	0	17
e. shelterbelts	Unshelt	0	0	25	0	3
	Shelt	59	100	0	100	72
f. contour cultivation	Unshelt	0	9	0	33	8
	Shelt	6	0	0	0	3
g. alternate height cutting	Unshelt	20	25	0	0	17
	Shelt	13	0	0	0	5
h. habitat conservation	Unshelt	13	0	25	33	11
	Shelt	25	30	20	18	24

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		Fertile Valley	Auvergne	Stanley	Edward	All RM's
1. Q#5 - How would you rate the following in terms of their importance in determining what crops you seed? (% important or very important)						
a. commodity price	Unshelt	80	91	100	100	89
	Shelt	94	91	100	90	93
b. distance to elevators	Unshelt	86	58	25	100	64
	Shelt	50	60	40	33	47
c. crop rotation	Unshelt	78	70	100	100	81
	Shelt	93	44	100	78	79
d. input costs	Unshelt	78	91	75	100	85
	Shelt	100	70	80	78	85
e. soil moisture conditions	Unshelt	89	91	100	100	92
	Shelt	87	80	80	89	85
f. conservation concerns	Unshelt	100	80	50	100	84
	Shelt	79	60	80	100	79
g. equipment restrictions	Unshelt	100	80	75	100	88
	Shelt	87	60	80	100	82
h. crop management level	Unshelt	100	80	75	100	88
	Shelt	93	50	80	78	76
i. rockiness	Unshelt	40	40	67	50	45
	Shelt	50	70	67	67	61
2. Q#13 - How would you rate the following in their effect on crop yields in this quarter section? (% important or very important)						
a. salinity	Unshelt	22	50	0	0	27
	Shelt	75	33	60	44	56
b. water erosion	Unshelt	13	36	50	0	27
	Shelt	44	22	60	33	38
c. wind erosion	Unshelt	40	45	50	67	46
	Shelt	33	33	60	70	46
d. rockiness	Unshelt	0	50	0	0	21
	Shelt	29	10	0	33	21
e. hilliness	Unshelt	29	30	0	0	21
	Shelt	7	11	0	11	8
f. drainage	Unshelt	43	33	0	0	26
	Shelt	60	11	60	44	45
3. Q#15 - How would you rate the following for their importance in determining the field size on this quarter section? (% important or very important)						
a. hills	Unshelt	29	25	25	0	24
	Shelt	9	0	0	0	3
b. waterways	Unshelt	29	40	75	100	48
	Shelt	46	11	40	0	25
c. equipment size	Unshelt	43	11	50	67	35
	Shelt	27	33	40	11	26
d. crop rotation	Unshelt	67	50	50	50	56
	Shelt	64	38	100	11	48
e. bush	Unshelt	0	13	50	100	24
	Shelt	9	0	20	11	9
f. sloughs	Unshelt	57	38	25	50	43
	Shelt	50	30	20	33	36
g. shelterbelts	Unshelt	33	13	0	50	20
	Shelt	62	75	100	89	77
4. Q#14 - Are any of the following used on this quarter section? (% Yes)						
a. strip-cropping	Unshelt	50	100	0	0	59
	Shelt	6	70	0	36	29
b. grass barriers	Unshelt	20	8	25	0	14
	Shelt	6	20	0	9	10
c. permanent forages	Unshelt	20	18	25	0	18
	Shelt	13	40	0	22	21
d. grassed waterways	Unshelt	11	42	75	0	32
	Shelt	19	30	20	0	17
e. shelterbelts	Unshelt	0	0	25	0	4
	Shelt	99	100	80	100	93
f. contour cultivation	Unshelt	0	9	0	33	8
	Shelt	6	0	0	0	3
g. alternate height cutting	Unshelt	20	25	0	0	17
	Shelt	13	0	0	0	5
h. habitat conservation	Unshelt	13	0	25	33	11
	Shelt	25	30	20	18	24

Appendix II. Other information from Producer Survey

		Fertile Valley	Auvergne	Stanley	Edward	All RM's
1. Q#1 - How many years have you been farming?						
more than 20	Unshelt	70%	83%	75%	100%	79%
	Shelt	75%	90%	100%	73%	81%
10 to 20	Unshelt	30%	17%	25%	0%	21%
	Shelt	19%	10%	0%	9%	12%
less than 10	Unshelt	0%	0%	0%	0%	0%
	Shelt	6%	0%	0%	18%	7%
2. Q#2 - What is your current farming operation?						
Grain	Unshelt	60%	33%	25%	25%	40%
	Shelt	78%	27%	17%	36%	48%
Grain/Livestock	Unshelt	40%	67%	50%	50%	53%
	Shelt	11%	73%	17%	55%	37%
Other	Unshelt	0%	0%	25%	25%	7%
	Shelt	11%	0%	66%	9%	15%
3. Q#3 - Which seeding and tillage practices do you use in your operation?						
Direct seeding	Unshelt	29%	20%	25%	33%	24%
	Shelt	45%	14%	43%	53%	37%
Conventional seeding	Unshelt	29%	23%	50%	67%	30%
	Shelt	23%	38%	57%	20%	31%
Summerfallowing	Unshelt	24%	37%	25%	13%	30%
	Shelt	18%	38%	0%	0%	22%
Chem-fallowing	Unshelt	18%	20%	0%	13%	17%
	Shelt	14%	10%	0%	0%	11%
4. Q#4 - How would you rate the importance of the following in your farming operations? (% important or very important)						
Fertilizers	Unshelt	80%	92%	75%	100%	86%
	Shelt	87%	90%	100%	78%	87%
Herbicides	Unshelt	80%	91%	75%	100%	86%
	Shelt	81%	100%	100%	70%	85%
Insecticides	Unshelt	75%	67%	75%	100%	75%
	Shelt	60%	75%	100%	89%	76%
Fungicides	Unshelt	50%	50%	50%	100%	56%
	Shelt	57%	14%	100%	33%	49%
Organic Production	Unshelt	17%	33%	25%	50%	28%
	Shelt	0%	0%	60%	0%	10%
Irrigation	Unshelt	17%	25%	0%	0%	13%
	Shelt	0%	29%	80%	0%	19%
5. Q#6 - How do you harvest your crops?						
Swath	Unshelt	50%	58%	50%	33%	52%
	Shelt	25%	60%	0%	0%	24%
Straight-cut	Unshelt	20%	25%	0%	0%	17%
	Shelt	50%	40%	0%	10%	32%
Both	Unshelt	30%	17%	50%	67%	31%
	Shelt	25%	0%	100%	90%	44%

6. Q#7- What percentage of the total land base you farm is protected by shelterbelts?							
	0-50%	Unshelt	90%	83%	75%	67%	83%
		Shelt	14%	50%	0%	55%	45%
	51-100%	Unshelt	10%	17%	25%	33%	17%
		Shelt	86%	50%	100%	45%	55%
7. Q#8 - How important are the following in keeping you informed about conservation issues and technology?							
	Newspaper	Unshelt	78%	91%	100%	100%	88%
		Shelt	81%	90%	60%	75%	79%
	Radio	Unshelt	75%	89%	67%	100%	83%
		Shelt	64%	80%	60%	75%	70%
	Television	Unshelt	50%	70%	0%	100%	57%
		Shelt	80%	78%	40%	38%	65%
	Internet	Unshelt	25%	22%	0%	50%	23%
		Shelt	29%	0%	0%	13%	14%
	Farm shows / Field days	Unshelt	70%	70%	33%	100%	68%
		Shelt	56%	50%	100%	75%	64%
	Newsletters, Magazines, Brochures	Unshelt	88%	90%	67%	100%	87%
		Shelt	79%	100%	100%	88%	89%
	Extension & / or research people	Unshelt	100%	80%	67%	100%	87%
		Shelt	71%	56%	60%	63%	64%
	Other producers	Unshelt	67%	75%	67%	100%	74%
		Shelt	79%	75%	60%	67%	72%
	Conservation groups	Unshelt	0%	60%	67%	100%	46%
		Shelt	60%	29%	75%	71%	57%
8. Q#9 - How many years have you been farming this quarter section?							
	0-5 years	Unshelt	0%	8%	0%	0%	3%
		Shelt	13%	0%	0%	9%	7%
	5-10 years	Unshelt	20%	8%	1%	33%	17%
		Shelt	13%	20%	0%	36%	19%
	10-20 years	Unshelt	20%	17%	25%	33%	21%
		Shelt	13%	20%	20%	18%	17%
	More than 20 years	Unshelt	60%	67%	50%	33%	59%
		Shelt	62%	60%	80%	36%	57%
9. Q#10 - How did you acquire this land?							
	Inherited	Unshelt	18%	0%	0%	0%	6%
		Shelt	13%	10%	20%	9%	12%
	Purchased from non-family members	Unshelt	36%	54%	75%	25%	47%
		Shelt	25%	50%	40%	45%	38%
	Purchased from family members	Unshelt	18%	8%	25%	25%	16%
		Shelt	31%	10%	0%	36%	24%
	Purchased from financial institution	Unshelt	9%	23%	0%	25%	16%
		Shelt	0%	20%	20%	0%	7%
	Lease land	Unshelt	18%	15%	0%	25%	16%
		Shelt	31%	10%	20%	9%	19%
10. Q#18 - What is the history of the shelterbelts on this land? (Producers with shelterbelts only)							
	Planted before I started farming it		94%	80%	50%	91%	85%
	I planted them		6%	20%	50%	9%	15%

APPENDIX III - Survey questionnaire

IHARF

SUSTAINABLE FARMING PRACTICES

A Survey of Saskatchewan
and Manitoba Producers

FALL-WINTER 1997

Please return your completed questionnaire before November 15, 1997
in the enclosed envelope to:

The Indian Head Research Foundation
c/o Margaret Put
Box 156
Indian Head, Saskatchewan S0G 2K0

The questions in this survey are multiple choice. Generally, you should select one choice that best represents your answer unless more than one choice applies to you. Where you are asked to rate the importance of issues on a 1-4 scale, please circle only one number. There are no correct or incorrect choices so please select whatever answer best represents your opinion.

Q1 **How many years have you been farming?** *(Please circle one choice)*

1 0-5 YEARS
2 5-10 YEARS
3 10-20 YEARS
4 MORE THAN 20 YEARS

Q2 **What is your current farming operation?** *(Please circle one choice)*

1 GRAIN
2 GRAIN AND LIVESTOCK
3 OTHER
*(Please specify)*_____

Q3 **Which seeding and tillage practices do you use in your operations?** *(Please circle all choices that apply to you)*

1 DIRECT SEEDING
2 CONVENTIONAL SEEDING
4 SUMMERFALLOWING
5 CHEM-FALLOWING
6 OTHER
(Please specify) _____

Q4 **How would you rate the importance of the following in your farming operations?** *(Please circle a number for all choices that apply to you)*

		VERY UNIMPORTANT	SOMEWHAT UNIMPORTANT	SOMEWHAT IMPORTANT	VERY IMPORTANT
1	FERTILIZERS	1	2	3	4
2	HERBICIDES	1	2	3	4
3	INSECTICIDES	1	2	3	4
4	FUNGICIDES	1	2	3	4
5	ORGANIC PRODUCTION	1	2	3	4
6	IRRIGATION	1	2	3	4
7	OTHER *(Please specify and rate)* _____	1	2	3	4

Q5 **Please rate the following factors in terms of their importance in determining what crops you seed?** *(Please circle one choice for each possible factor)*

		VERY UNIMPORTANT	SOMEWHAT UNIMPORTANT	SOMEWHAT IMPORTANT	VERY IMPORTANT
1	PRICE	1	2	3	4
2	DISTANCE TO ELEVATORS	1	2	3	4
3	CROP ROTATION REQUIREMENTS	1	2	3	4
4	INPUT COSTS	1	2	3	4
5	SOIL MOISTURE CONDITIONS	1	2	3	4
6	CONSERVATION CONCERNS	1	2	3	4
8	EQUIPMENT	1	2	3	4
9	LEVEL OF CROP MANAGEMENT REQUIRED	1	2	3	4
10	ROCKINESS	1	2	3	4
11	OTHER *(Please specify and rate)* _____	1	2	3	4

CONTINUED ON NEXT PAGE ...

Q6 **How do you harvest your crops?** *(Please circle one choice)*

1	SWATH	3	BOTH
2	STRAIGHT-CUT	4	OTHER *(Please specify)*_____

Q7 **What percentage of the total land base you farm is protected by shelterbelts? (i.e. 4 out of 5 quarters = 80%)** *(Please circle one choice)*

1	0 %	4	51-75 %
2	1-25 %	5	76-99 %
3	26-50 %	6	100 %

Q8 **How important are the following in keeping you informed about conservation issues and technology?** *(Please rate each possible source in terms of its importance to you)*

		VERY UNIMPORTANT	SOMEWHAT UNIMPORTANT	SOMEWHAT IMPORTANT	VERY IMPORTANT
1	NEWSPAPERS	1	2	3	4
2	RADIO	1	2	3	4
3	TELEVISION	1	2	3	4
4	INTERNET	1	2	3	4
5	FARM SHOWS/FIELD DAYS	1	2	3	4
6	NEWSLETTERS, MAGAZINES OR BROCHURES	1	2	3	4
7	EXTENSION &/OR RESEARCH PEOPLE	1	2	3	4
8	OTHER PRODUCERS	1	2	3	4
9	BELONG TO PRODUCER GROUP(S) *(Please specify and rate its importance to you)* _____	1	2	3	4
9	BELONG TO CONSERVATION GROUP (S) *(Please specify and rate its importance to you)* _____	1	2	3	4

We would now like to ask some questions specifically relating to quarter section

Q9 **How many years have you been farming this quarter section?** *(Please circle one choice)*

1	0-5 YEARS	3	10-20 YEARS
2	5-10 YEARS	4	MORE THAN 20 YEARS

Q10 **How did you acquire this land?** *(Please circle one choice)*

1 INHERITED
2 PURCHASED FROM NON-FAMILY MEMBERS
3 PURCHASED FROM FAMILY MEMBERS
4 PURCHASED FROM FINANCIAL INSTITUTION (I.E. FCC, BANK, ETC.)
5 LEASE LAND

CONTINUED ON NEXT PAGE ...

Q11 **Please describe the seeding equipment you use on this quarter section**

1 LOW-DISTURBANCE DIRECT SEEDING *(Please specify)*

_____

_____

_____

2 HIGH-DISTURBANCE DIRECT SEEDING (Please specify)

_____

_____

_____

3 CONVENTIONAL SEEDING *(Please specify)*

_____

_____

_____

Q12 **If tillage is part of your farming system, please indicate when tilling occurs** *(Please circle one choice)*

1 PRE-SEEDING (SPRING)
2 POST-HARVEST (FALL)
3 SUMMER FALLOW (SUMMER) *(Please specify number of times you would normally cultivate your summerfallow)*

_____

Q13 **Please rate the following in their effect on crop yields on this quarter section**

		VERY	SOMEWHAT UNIMPORTANT	SOMEWHAT IMPORTANT	VERY
1	SALINITY	1	2	3	4
2	WATER EROSION	1	2	3	4
3	WIND EROSION	1	2	3	4
4	ROCKINESS	1	2	3	4
5	HILLINESS	1	2	3	4
6	DRAINAGE	1	2	3	4
7	OTHER *(Please specify and rate its importance to you)* _____	1	2	3	4

Q14 **Are any of the following used on this quarter section?** *(Please circle one choice)*

1	STRIP CROPPING	YES	NO	SOMETIMES
2	GRASS BARRIERS	YES	NO	SOMETIMES
3	PERMANENT FORAGES	YES	NO	SOMETIMES
4	GRASSED WATERWAYS	YES	NO	SOMETIMES
5	SHELTERBELTS	YES	NO	SOMETIMES
6	CONTOUR CULTIVATION	YES	NO	SOMETIMES
7	ALTERNATE HEIGHT CUTTING	YES	NO	SOMETIMES
8	HABITAT PRESERVATION	YES	NO	SOMETIMES
9	OTHER *(Please specify)*	_____		

CONTINUED ON NEXT PAGE...

Q15 **Please rate the following factors for their importance in determining field sizes on this quarter section** *(Please circle a number for all choices that apply to you)*

		VERY UNIMPORTANT	SOMEWHAT UNIMPORTANT	SOMEWHAT IMPORTANT	VERY IMPORTANT
1	HILLS	1	2	3	4
2	WATERWAYS	1	2	3	4
3	EQUIPMENT SIZE	1	2	3	4
4	CROP ROTATION	1	2	3	4
5	BUSH	1	2	3	4
6	SLOUGHS OR LOW SPOTS	1	2	3	4
7	SHELTERBELTS	1	2	3	4
8	OTHER *(Please specify and rate its importance to you)* _____	1	2	3	4

Q16 **Are there shelterbelts on this quarter section?** *(Please circle one choice)*
If 'NO' . . . go to Q20.

1 YES
2 NO

THE NEXT THREE QUESTIONS ARE FOR PRODUCERS WHO HAVE SHELTERBELTS. PLEASE SKIP THESE QUESTIONS IF YOU DO NOT HAVE SHELTERBELTS ON THIS QUARTER.

Q17 **How do shelterbelts affect the following management decisions?** *(Please circle one number for each choice)*

		NOT AT ALL 1	VERY LITTLE 2	SOMEWHAT 3	CONSIDERABLY 4
1	FIELD SIZE	1	2	3	4
2	CHOICE OF CROPS	1	2	3	4
3	FREQUENCY OF TILLAGE	1	2	3	4
4	SUMMERFALLOW ACREAGE	1	2	3	4

IMPORTANT: IF YOU CHOSE "SOMEWHAT" OR "CONSIDERABLY", PLEASE ELABORATE IN THE SPACE PROVIDED BELOW ...

_____

_____

_____

_____

_____

Q18 **What is the history of the shelterbelts on this quarter section?** *(Please circle one choice)*
1 PLANTED BEFORE I STARTED FARMING THIS LAND
2 I PLANTED SHELTERBELTS

Q19 **How old are the shelterbelts?** *(Please indicate on the line below)*

_____

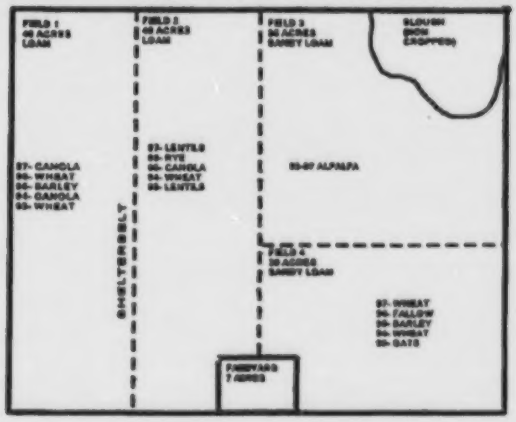
CONTINUED ON NEXT PAGE ...

All producers please complete the following:

Q20 **Using your farm records for the last five years, please sketch the fields on this quarter. Please record the following information:**

a. crops grown for the last five years (1993-1997)
b. acres seeded for each crop
c. soil texture for each field (eg. sandy loam, loam, silt loam, clay loam, clay, etc.)

EXAMPLE:



YOUR QUARTER SECTION: QUARTER ___ SECTION ___ TOWNSHIP ___ RANGE ___ MERIDIAN ___

(Please note - the acreage should total 160 for the quarter section)